Recent Application of Nuclear Data to Fast Reactor Core Analysis and Design in Japan

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Recently, some improvements of the nuclear data application to the fast reactor core field have been accomplished in Japan.

Development of group constants and analytical tools

First, an ABBN-type 70-group constant set has been used conventionally for fast reactor analysis in Japan. In order to improve the applicability of the group constant to various types of reactor cores and to treat exactly the interference effect of resonance peaks between mixed isotopes in a cell, a new cell calculation system with an ultra-fine group constant set which has more than 100,000 group structure has been developed and opened to public. Second, to process the ENDF-type covariance file including resonance parameters, angular scattering distribution, a code ERRORJ, which is an extended version of the NJOY-ERRORR module, has been developed and released through OECD/NEA. Third, an analytical system to calculate the cross-section sensitivity coefficients of various core parameters including burnup characteristics and Doppler reactivity has been prepared as one part of neutronics system for fast reactor analysis. The sensitivity coefficient is a very powerful tool to understand some physical mechanism caused by nuclear data and to analyze the effect of difference between libraries.

Consistent evaluation of nuclear data by fast reactor experimental database

Recently, a set of fast reactor experimental database, most of which can be opened to public, has been compiled and completed by JNC. The database includes, the JUPITER large-size fast core critical experiment program using ZPPR facility at ANL-Idaho, the MOZART middle-size core project at ZEBRA facility in UK, the FCA small-core critical experiments at JAERI in Japan, the BFS critical experiments at IPPE in Russia, the MASURCA critical experiments at Cadarache, in France, the physics test and operational data of the JOYO experimental power reactor in Japan, the old Los Alamos small core experiment, etc. JNC is also evaluating the burnup composition changes of the JOYO driver fuels and minor actinide samples. The JENDL library was systematically applied to these various integral data and the performance and consistency of the C/E(calculation/experiment) values were investigated in detail.

Improvement of prediction accuracy and application to fast reactor design study

To utilize the above critical experimental data and power reactor operational experience to the design work, the most powerful method is to adjust the cross-sections based on the Bayesian theory and least-square technique, where all related information including C/E values, experimental and analytical errors, sensitivity coefficients of various experimental cores and parameters, and cross-section covariance, is synthesized with physical consistency. Here the adjusted cross-section set is called a "unified cross-section" set which means a physical combination of the integral experimental information with differential nuclear data. A newest unified cross-section set, ADJ2000R, has been successfully developed and used in the design calculation of the FBR cycle feasibility study in Japan. Since a lot of experience has got from the nuclear data application to the design study in Japan, JNC will express some opinions and future needs to the nuclear data study from a user viewpoint in the presentation.

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